

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

Claims 1-11. (canceled).

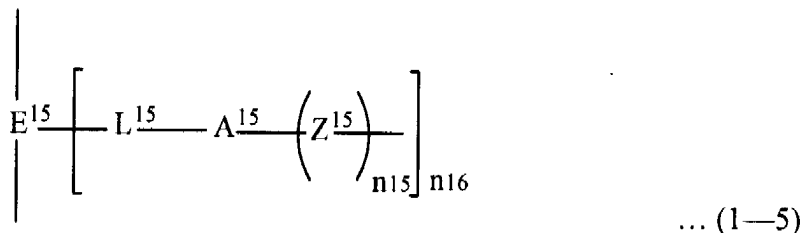
Claim 12. (original): An organic-inorganic hybrid proton-conductive material containing an organic-inorganic hybrid material and a proton source which imparts proton conductivity into the organic-inorganic hybrid material, and wherein the organic-inorganic hybrid material is produced by crosslinking a precursor that is an organosilicon compound having a mesogen group.

Claim 13. (original): The organic-inorganic hybrid proton-conductive material of claim 12, wherein the organic-inorganic hybrid material is produced by three-dimensionally crosslinking the precursor.

Claim 14. (original): The organic-inorganic hybrid proton-conductive material of claim 12, wherein the proton source is at least one selected from the group consisting of phosphorus compounds, organic sulfonic acids and perfluorocarbonsulfonic acid polymers.

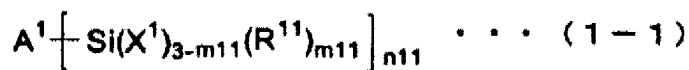
Claim 15. (currently amended): The organic-inorganic hybrid proton-conductive material of claim 12, wherein the organic-inorganic hybrid material further comprises at least one compound of ~~the following formulae (1-4) and~~ formula (1-4) or a polymer having a

repeating unit of the formula (1-5), and wherein the amount of the at least one compound or polymer is in the range of from 1 mol% to 50 mol % relative to the precursor:



wherein, in formulae (1-4) and (1-5), A^{14} and A^{15} each represents an organic atomic group that contains a mesogen and an alkylene group having at least 4 carbon atoms; Z^{14} and Z^{15} each represents a substituent not changing in sol-gel reaction, or a hydrogen atom; $n13$ and $n15$ each indicates an integer of from 1 to 8; $n14$ indicates an integer of from 0 to 4; $n16$ indicates an integer of from 1 to 5; Y^{14} represents a polymerizing group that may form a carbon-carbon bond or a carbon-oxygen bond through polymerization; L^{15} represents a linking group; E^{15} represents an alkyleneoxy group, an alkylene group or a siloxy group; and when $n13$ or $n15$ is 2 or more, then Z^{14} 's or Z^{15} 's may be the same or different.

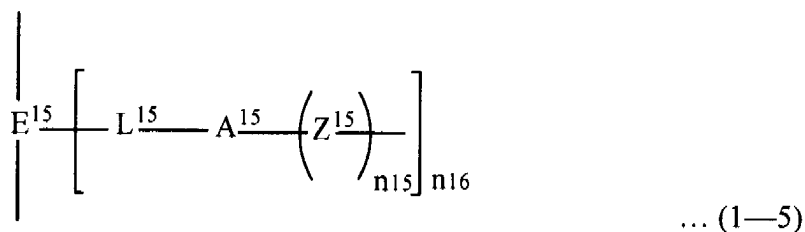
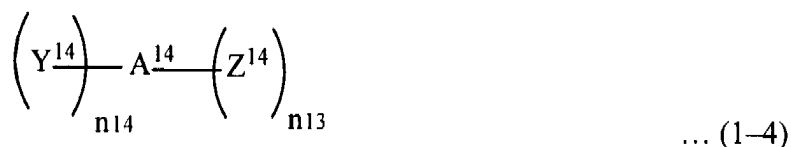
Claim 16. (original): The organic-inorganic hybrid proton-conductive material of claim 12, the organic-inorganic hybrid material is produced by polymerizing a compound of the following formula (1-1) :



wherein A^I represents an organic atomic group that contains a mesogen group and an alkylene group having at least 4 carbon atoms; R^{II} represents an alkyl group, an aryl group or a heterocyclic group; X^I represents a halogen atom or OR¹⁴; R¹⁴ represents a hydrogen atom, an alkyl group, an aryl group or a silyl group; mll indicates an integer of from 0 to 2; nil indicates an integer of from 1 to 10; when mll or 3-mll is 2 or more, then R¹¹'s or X¹'s may be the same or different.

Claim 17. (original): The organic-inorganic hybrid proton-conductive material of claim 16, wherein the proton source is at least one selected from the group consisting of phosphorus compounds, organic sulfonic acids and perfluorocarbonsulfonic acid polymers.

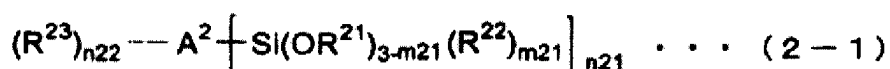
Claim 18. (currently amended): The organic-inorganic hybrid proton-conductive material of claim 16, wherein the organic-inorganic hybrid material further comprises at least one compound of ~~the following formulae (1-4) and~~ formula (1-4) or a polymer having a repeating unit of the formula (1-5), and wherein the amount of the at least one compound or polymer is in the range of from 1 mol% to 50 mol% relative to the precursor:



wherein, in formulae (1-4) and (1-5), A^{14} and A^{15} each represents an organic atomic group that contains a mesogen and an alkylene group having at least 4 carbon atoms; Z^{14} and Z^{15} each represents a substituent not changing in sol-gel reaction, or a hydrogen atom; n_{13} and n_{15} each indicates an integer of from 1 to 8; n_{14} indicates an integer of from 0 to 4; n_{16} indicates an integer of from 1 to 5; Y^{14} represents a polymerizing group that may form a carbon-carbon bond or a carbon-oxygen bond through polymerization; L^{15} represents a linking group; E^{15} represents an alkyleneoxy group, an alkylene group or a siloxy group; and when n_{13} or n_{15} is 2 or more, then Z^{14} 's or Z^{15} 's may be the same or different.

Claim 19. (previously presented): The organic-inorganic hybrid proton-conductive material of claim 12, wherein the organic-inorganic hybrid material is produced by three-dimensionally crosslinking a precursor that is an organosilicon compound that has an alkoxysilyl group, a mesogen group and a substituent group capable of forming a carbon-carbon bond or a carbon-oxygen bond through polymerization.

Claim 20. (original): The organic-inorganic hybrid proton-conductive material of claim 19, wherein the organic-inorganic hybrid material is produced through sol-gel reaction of a precursor that is an organosilicon compound of the following formula (2-1) to form an Si-O-Si bond, combined with polymerization of the substituent in the organosilicon compound to form a carbon-carbon bond or a carbon-oxygen bond:

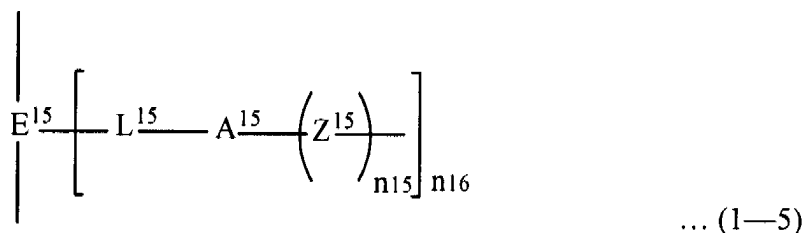
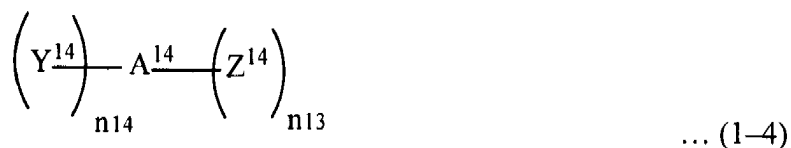


wherein A^2 represents an organic atomic group containing a mesogen group; R^{21} represents an alkyl group; R^{22} represents an alkyl group, an aryl group or a heterocyclic group; R^{23} represents a

substituent group capable of forming a carbon-carbon bond or a carbon-oxygen bond through polymerization; m21 indicates an integer of from 0 to 2; n21 indicates an integer of from 1 to 10; n22 indicates an integer of from 1 to 5; when 3-m21 or m21 is 2 or more, then R²¹'s or R²²'s may be the same or different; when n22 is 2 or more, then R²³'s may be the same or different.

Claim 21. (original): The organic-inorganic hybrid proton-conductive material of claim 20, wherein the proton source is at least one selected from the group consisting of phosphorus compounds, organic sulfonic acids and perfluorocarbonsulfonic acid polymers.

Claim 22. (currently amended): The organic-inorganic hybrid proton-conductive material of claim 20, wherein the organic-inorganic hybrid material further comprises at least one compound of ~~the following formulae (1-4) and~~ formula (1-4) or a polymer having a repeating unit of the formula (1-5), and wherein the amount of the at least one compound or polymer is in the range of from 1 mol% to 50 mol% relative to the precursor:

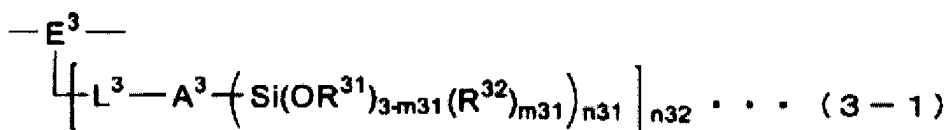


wherein, in formulae (1-4) and (1-5), A¹⁴ and A¹⁵ each represents an organic atomic group that contains a mesogen and an alkylene group having at least 4 carbon atoms; Z¹⁴ and Z¹⁵ each represents a substituent not changing in sol-gel reaction, or a hydrogen atom; n13 and n15 each

indicates an integer of from 1 to 8; n₁₄ indicates an integer of from 0 to 4; n₁₆ indicates an integer of from 1 to 5; Y¹⁴ represents a polymerizing group that may form a carbon-carbon bond or a carbon-oxygen bond through polymerization; L¹⁵ represents a linking group; E¹⁵ represents an alkyleneoxy group, an alkylene group or a siloxy group; and when n₁₃ or n₁₅ is 2 or more, then Z¹⁴'s or Z¹⁵'s may be the same or different.

Claim 23. (original): The organic-inorganic hybrid proton-conductive material of claim 12, wherein the organic-inorganic hybrid material is produced through crosslinking polymerization of a precursor that is produced through crosslinking polymerization of a precursor that is a polymer having, in the side branches thereof, an atomic group that contains an alkoxysilyl group, a mesogen group and an alkylene group.

Claim 24. (original): The organic-inorganic hybrid proton-conductive material of claim 23, wherein the organic-inorganic hybrid material is produced by a precursor is a polymer having a repeating unit of the following formula (3-1):

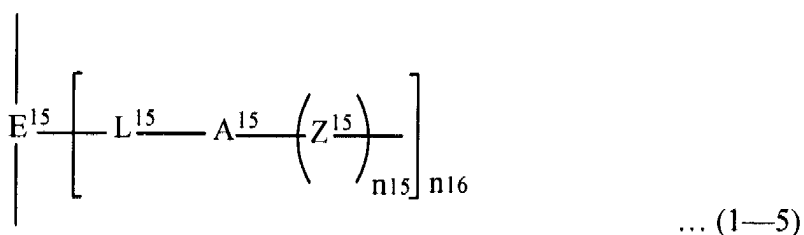
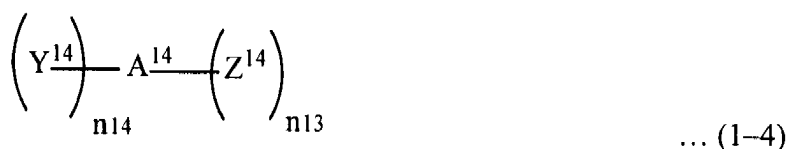


wherein A³ represents an organic atomic group that contains a mesogen group and an alkylene group; R³¹ represents an alkyl group; R³² represents an alkyl group, an aryl group or a heterocyclic group; E³ represents an alkyleneoxy group, an alkylene group or a siloxy group; L³ represents a linking group; m₃₁ indicates an integer of from 0 to 2 ; n₃₁ indicates an integer of

from 1 to 10; n₃₂ indicates an integer of from 1 to 5; when 3-m₃₁ or m₃₁ is 2 or more, then R³¹'s or R³²'s may be the same or different.

Claim 25. (original): The organic-inorganic hybrid proton-conductive material of claim 24, wherein the proton source is at least one selected from the group consisting of phosphorus compounds, organic sulfonic acids and perfluorocarbonsulfonic acid polymers.

Claim 26. (currently amended): The organic-inorganic hybrid proton-conductive material of claim 24, wherein the organic-inorganic hybrid material further comprises at least one compound of ~~the following formulae (1-4) and formula (1-4)~~ or a polymer having a repeating unit of the formula (1-5), and wherein the amount of the at least one compound or polymer is in the range of from 1 mol% to 50 mol% relative to the precursor:



wherein, in formulae (1-4) and (1-5), A¹⁴ and A¹⁵ each represents an organic atomic group that contains a mesogen and an alkylene group having at least 4 carbon atoms; Z¹⁴ and each represents a substituent not changing in sol-gel reaction, or a hydrogen atom; n₁₃ and n₁₅ each indicates an integer of from 1 to 8; n₁₄ indicates an integer of from 0 to 4; n₁₆ indicates an integer of from 1 to 5; Y¹⁴ represents a polymerizing group that may form a carbon-carbon bond

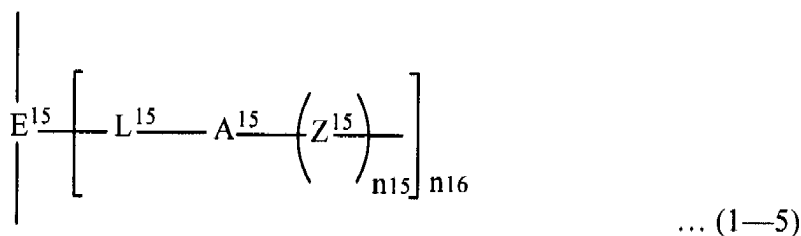
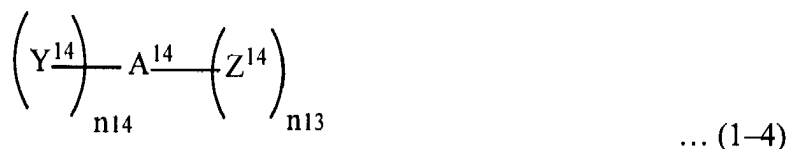
or a carbon-oxygen bond through polymerization; L^{15} represents a linking group; E^{15} represents an alkyleneoxy group, an alkylene group or a siloxy group; and when n_{13} or n_{15} is 2 or more, then Z^{14} 's or Z^{15} 's may be the same or different.

Claim 27. (original): A fuel cell that comprises an organic-inorganic hybrid proton-conductive material, wherein the organic-inorganic hybrid proton-conductive material containing a organic-inorganic hybrid material and a proton source which imparts proton conductivity into the organic-inorganic hybrid material, and wherein the organic-inorganic hybrid material is produced by crosslinking a precursor that is an organosilicon compound having a mesogen group.

Claim 28. (original): The fuel cell of claim 27, wherein the organic-inorganic hybrid material is produced by three-dimensionally crosslinking the precursor.

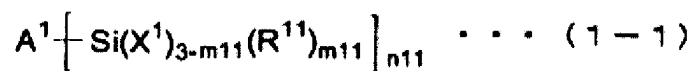
Claim 29. (previously presented): The fuel cell of claim 27, wherein the proton source is at least one selected from the group consisting of phosphorus compounds, organic sulfonic acids and perfluorocarbonsulfonic acid polymers.

Claim 30. (currently amended): The fuel cell of claim 27, wherein the organic-inorganic hybrid material further comprises at least one compound of ~~the following formulae (1-4) and formula (1-4)~~ a polymer having a repeating unit of the formula (1-5), and the amount of the at least one compound or polymer is in the range of from 1 mol % to 50 mol % relative to the precursor:



wherein, in formulae (1-4) and (1-5), A^{14} and A^{15} each represents an organic atomic group that contains a mesogen and an alkylene group having at least 4 carbon atoms; Z^{14} and Z^{15} each represents a substituent not changing in sol-gel reaction, or a hydrogen atom; $n13$ and $n15$ each indicates an integer of from 1 to 8; $n14$ indicates an integer of from 0 to 4; $n16$ indicates an integer of from 1 to 5; Y^{14} represents a polymerizing group that may form a carbon-carbon bond or a carbon-oxygen bond through polymerization; L^{15} represents a linking group; E^{15} represents an alkyleneoxy group, an alkylene group or a siloxy group; and when $n13$ or $n15$ is 2 or more, then Z^{14} 's or Z^{15} 's may be the same or different.

Claim 31. (previously presented): The fuel cell of claim 27, wherein the organic-inorganic hybrid material is produced by polymerizing a compound of the following formula (1-1):

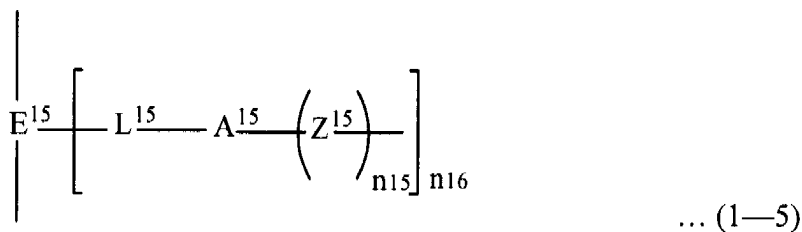
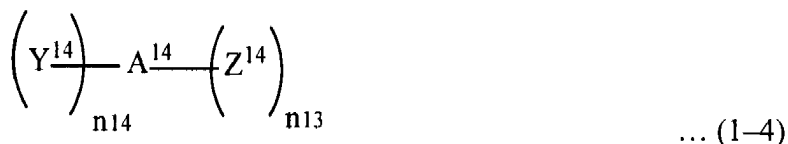


wherein A^1 represents an organic atomic group that contains a mesogen group and an alkylene group having at least 4 carbon atoms; R^{11} represents an alkyl group, an aryl group or a heterocyclic group; X^1 represents a halogen atom or OR^{14} ; R^{14} represents a hydrogen atom, an

alkyl group, an aryl group or a silyl group; mll indicates an integer of from 0 to 2; nll indicates an integer of from 1 to 10; when mll or 3-mll is 2 or more, then R¹¹'s or X¹¹'s may be the same or different.

Claim 32. (previously presented): The fuel cell of claim 31, wherein the proton source is at least one selected from the group consisting of phosphorus compounds, organic sulfonic acids and perfluorocarbonsulfonic acid polymers.

Claim 33. (currently amended): The fuel cell of claim 31, wherein the organic-inorganic hybrid material further comprises at least one compound of ~~the following formulae (1-4) and~~ formula (1-4) or a polymer having a repeating unit of the formula (1-5), and wherein the amount of the at least one compound or polymer is in the range of from 1 mol% to 50 mol% relative to the precursor:



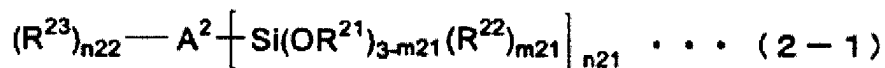
wherein, in formulae (1-4) and (1-5), A¹⁴ and A¹⁵ each represents an organic atomic group that contains a mesogen and an alkylene group having at least 4 carbon atoms; Z¹⁴ and Z¹⁵ each represents a substituent not changing in sol-gel reaction, or a hydrogen atom; n13 and n15 each indicates an integer of from 1 to 8; n14 indicates an integer of from 0 to 4; n16 indicates an

integer of from 1 to 5; Y^{14} represents a polymerizing group that may form a carbon-carbon bond or a carbon-oxygen bond through polymerization; L^{15} represents a linking group; E^{15} represents an alkyleneoxy group, an alkylene group or a siloxy group; and when n_{13} or n_{15} is 2 or more, then Z^{14} 's or Z^{15} 's may be the same or different.

Claim 34. (previously presented): The fuel cell of claim 27, wherein the organic-inorganic hybrid material is produced by three-dimensionally crosslinking a precursor that is an organosilicon compound that has an alkoxysilyl group, a mesogen group and a substituent group capable of forming a carbon-carbon bond or a carbon-oxygen bond through polymerization.

Claim 35. (previously presented): The fuel cell of claim 34, wherein the organic-inorganic hybrid material is produced through sol-gel reaction of a precursor that is an organosilicon compound of the following formula (2-1) to form an Si-O-Si bond, combined with polymerization

of the substituent in the organosilicon compound to form a carbon-carbon bond or a carbon-oxygen bond:

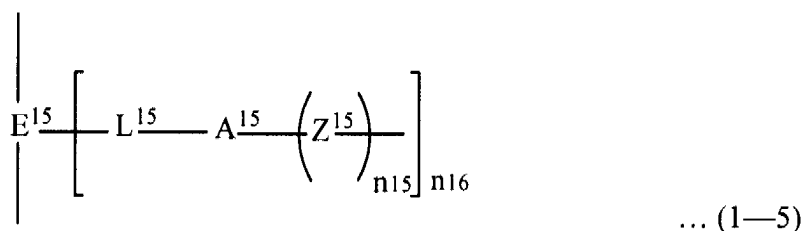
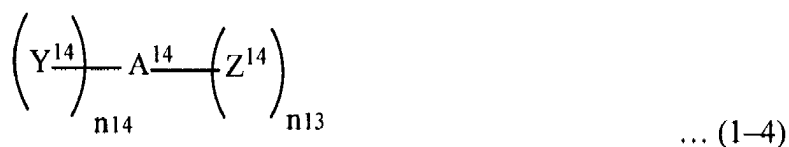


wherein A^2 represents an organic atomic group containing a mesogen group; R^{21} represents an alkyl group; R^{22} represents an alkyl group, an aryl group or a heterocyclic group; R^{23} represents a substituent group capable of forming a carbon-carbon bond or a carbon-oxygen bond through polymerization; m_{21} indicates an integer of from 0 to 2; n_{21} indicates an integer of from 1 to 10;

n22 indicates an integer of from 1 to 5; when 3-m21 or m21 is 2 or more, then R²¹'s or R²²'s may be the same or different; when n22 is 2 or more, then R²³'s may be the same or different.

Claim 36. (previously presented): The fuel cell of claim 35, wherein the proton source is at least one selected from the group consisting of phosphorus compounds, organic sulfonic acids and perfluorocarbonsulfonic acid polymers.

Claim 37. (currently amended): The fuel cell of claim 35, wherein the organic-inorganic hybrid material further comprises at least one compound of ~~the following formulae (1-4) and formula (1-4)~~ or a polymer having a repeating unit of the formula (1-5), and wherein the amount of the at least one compound or polymer is in the range of from 1 mol% to 50 mol% relative to the precursor:

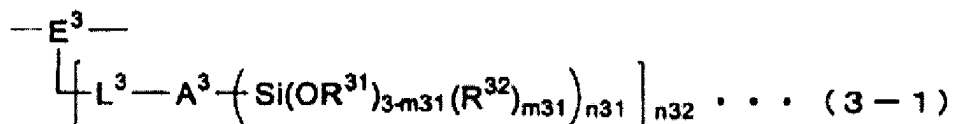


wherein, in formulae (1-4) and (1-5), A¹⁴ and A¹⁵ each represents an organic atomic group that contains a mesogen and an alkylene group having at least 4 carbon atoms; Z¹⁴ and Z¹⁵ each represents a substituent not changing in sol-gel reaction, or a hydrogen atom; n13 and n15 each indicates an integer of from 1 to 8; n14 indicates an integer of from 0 to 4; n16 indicates an integer of from 1 to 5; Y¹⁴ represents a polymerizing group that may form a carbon-carbon bond

or a carbon-oxygen bond through polymerization; L^{15} represents a linking group; E^{15} represents an alkyleneoxy group, an alkylene group or a siloxy group; and when n_{13} or n_{15} is 2 or more, then Z^{14} 's or Z^{15} 's may be the same or different.

Claim 38. (previously presented): The fuel cell of claim 27, wherein the organic-inorganic hybrid material is produced through crosslinking polymerization of a precursor that is a polymer having, in the side branches thereof, an atomic group that contains an alkoxysilyl group, a mesogen group and an alkylene group.

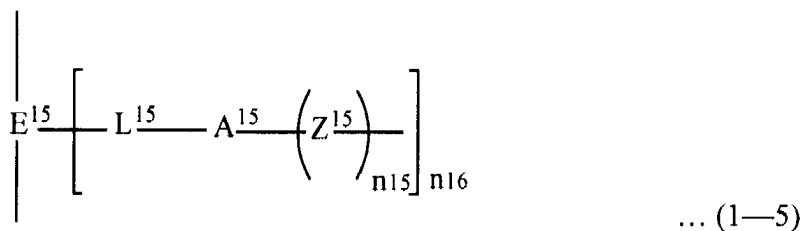
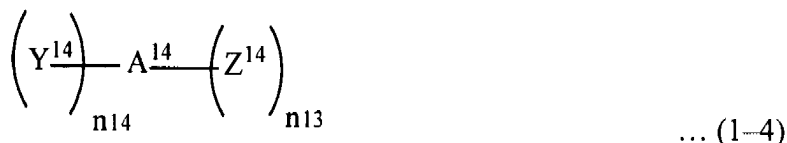
Claim 39. (previously presented): The fuel cell of claim 38, wherein the organic-inorganic hybrid material is produced by a precursor is a polymer having a repeating unit of the following formula (3-1) :



wherein A^3 represents an organic atomic group that contains a mesogen group and an alkylene group; R^{31} represents an alkyl group; R^{32} represents an alkyl group, an aryl group or a heterocyclic group; E^3 represents an alkyleneoxy group, an alkylene group or a siloxy group; L^3 represents a linking group; m_{31} indicates an integer of from 0 to 2 ; n_{31} indicates an integer of from 1 to 10; n_{32} indicates an integer of from 1 to 5; when $3-m_{31}$ or m_{31} is 2 or more, then R^{31} 's or R^{32} 's may be the same or different.

Claim 40. (previously presented): The fuel cell of claim 39, wherein the proton source is at least one selected from the group consisting of phosphorus compounds, organic sulfonic acids and perfluorocarbonsulfonic acid polymers.

Claim 41. (currently amended): The fuel cell of claim 39, wherein the organic-inorganic hybrid material further comprises at least one compound of ~~the following formulae (1-4) and formula (1-4)~~ or a polymer having a repeating unit of the formula (1-5), and the amount of the at least one compound or polymer is in the range of from 1 mol% to 50 mol% relative to the precursor:



wherein in formulae (1-4) and (1-5), A^{14} and A^{15} each represents an organic atomic group that contains a mesogen and an alkylene group having at least 4 carbon atoms; Z^{14} and Z^{15} each represents a substituent not changing in sol-gel reaction, or a hydrogen atom; $n13$ and $n15$ each indicates an integer of from 1 to 8; $n14$ indicates an integer from 0 to 4; $n16$ indicates an integer of from 1 to 5; Y^{14} represents a polymerizing group that may form a carbon-carbon bond or a carbon-oxygen bond through polymerization; L^{15} represents a linking group; E^{15} represents an alkyleneoxy group, an alkylene group or a siloxy group; and when $n13$ or $n15$ is 2 or more, then Z^{14} 's or Z^{15} 's may be the same or different.